Increasing Application of Modern Seasonal Rainfall Forecasts by Rural People through Understanding the Traditional Methods of Rainfall Forecasts.

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Milton Michael Waiswa (Principal Investigator)
Department of Meteorology, Ministry of Water, Lands and Environment,
P. 0. Box 7025 Kampala, Uganda. Tel: 256-41-233559/255609/251798
Mobile 256-71-287224, Fax: 256-41-251797

Abstract

Farmers in Soroti region were interviewed to investigate the major rainfall indictors they use during the dry season Jan-March to forecast the 1st seasonal rains (March-May). Statistical analysis using SPPS software, reveal the winds as the major rainfall indicator followed by clouds, trees, birds and temperatures. Winds and temperatures are common weather elements that farmers and meteorologists observe. Results further show that farmers in Soroti region associate strong winds blowing westwards during the dry season with late onset of March-May seasonal rains while winds blowing eastwards with early onset. Farmers associate low temperatures with early onset while high temperatures are associated with late onset. Historical records (1992-2003) of daily rainfall, wind speed and direction, maximum and minimum temperatures for Soroti weather station, were used to validate the farmer's knowledge of these rainfall indicators. Rainfall onset dates for the years 1992-2003 were analyzed using INSAT software. Average 5-day maximum and minimum temperatures and wind speed and direction for the first 90 Julian days were developed and correlated with rainfall onset dates. The wind speed of the Julian days 1-8 showed a strong positive(r=0.84) with onset periods. This suggests that the stronger the winds speed the later the seasonal rains start. This coincides with the farmers' observations. Maximum temperatures for the Julian days 1-8 had strong negative (r = -0.86) relationship with onset periods, implying the hotter the temperatures, the earlier the seasonal rains start while the cooler the temperatures, the later the season start. However during the Julian days 71-79, the maximum temperatures and onset dates have a strong positive (r = +0.80) relationship, which coincides with the farmers' observations. The local maximum temperatures and wind speed for Soroti region may be used to forecast onset dates for March-May seasonal rains ahead of 1-3 months. Secondly farmer's observations could be used to improve on the scientific climate information services

1.0 Introduction

Soroti region is found in Eastern Uganda. Due to its latitudinal location, positioned 1.7 degrees north of the equator, it exhibits a transitional rainfall pattern from bimodal to unimodal rainfall. The main crops include groundnuts, millet, and cassava, sorghum and sweet potatoes. The livestock is composed of cattle, goats, poultry and piggery. Climate is a major production problem followed by, marketing and labor shortage. The specific climate issues faced in this zone include droughts, prolonged dry seasons, erratic rains, hailstones and floods affecting the planting, harvesting, land opening and weeding farming activities

The effects of the climate problems, on the farming activities demand the use of climatic advisories. Currently there is availability of scientific climate advisories in terms of rainfall levels, produced by scientific community, however, use of these products by the farmers in rural communities, is not yet widespread (Srinivasan, 2000). The failure to link scientific knowledge with the existing farmers knowledge systems has been identified as one of the barriers for accepting scientific advisories. Farmers prefer using information that is related to their essential needs hence they resort to generating their climate forecasts based on their indigenous knowledge of forecasting. The integration of traditional forecasts could be an opportunity as entry point to enhance farmer's application of scientific climate forecasts. However for this to be possible it is required for the scientist to have some understanding on the farmers forecast to be able to assist the farmer integrate them with scientific ones.

2.0 Objective of the Study

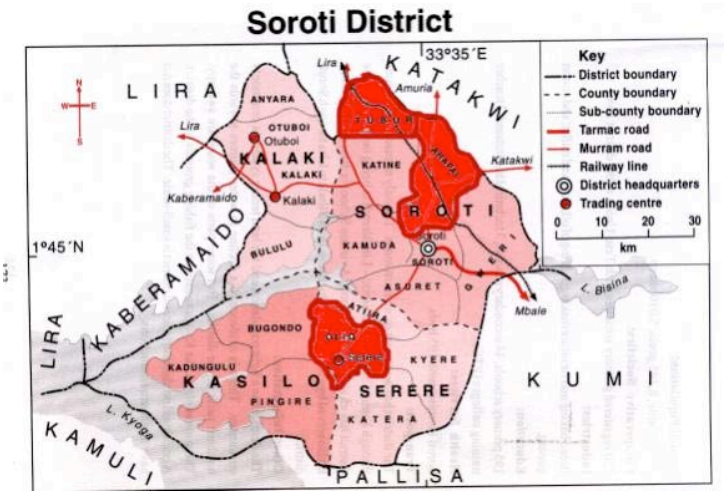
Based on the problems outlined above the objectives of this study included (i) investigate and document the traditional rainfall indicators used by rural people to forecast March-May seasonal rains, (ii) investigate the statistical relationship of these indicators with the, onset dates of March-May seasonal rains and (iii) identify periods with significant relationships.

3.0 Methodology,

Area of study

This study focused on Soroti region because of its I) high vulnerability to climate extremes, ii) presence of traditional knowledge of forecasting seasonal rains and iii) presence of an operational synoptic weather station. Within the Soroti region 4 areas (Olio, Arapai, Tibur and Usuk sub counties) were identified for the study. A questionnaire with open-ended questions was developed and used in the study (appendix I). The respondents in this survey where 77% male and 23% female. The age group of the respondents was 30%, 43% and 27% for age groups 20-39 years, 40-59 years and 60-79 years respectively.

Map of the Teso Zone



Research assistants working or residing within the region were identified to participate in the research survey. A two days workshop was conducted to train the research assistants in conducting the survey. A total of 120 farmers where interviewed by the research assistants. The interview was conducted during the middle of January and February 2003. Responses from the interviews were analyzed using SPSS (statistical) software.

Climate data

For purposes of using continuous data and keeping in mind the insecurity problems in the region under study, years of data analysis used for Soroti synoptic weather station ranged from 1992-2003. Historical daily rainfall, wind and temperatures data were obtained from Uganda Meteorological Department and entered into electronic format.

Daily data series of wind speed and direction, maximum and minimum temperatures data were analyzed using Microsoft EXCEL software to produce 5 day average values for the 1st 90 Julian days of the year. The daily rainfall data was analyzed by INSTAT software to identify the onset rainfall dates for the 1st wet season of each year. The determination of the onset dates using INSTAT software depended on the following, criteria I) earliest rainfall can start on the 60th day of the Julian calendar,

ii) rainfall is totaled over 5 consecutive days, iii) threshold for rain 4.95mm, iv) total rainfall exceeding 20 mm and v) number of rain days 3.

The data series of seasonal rainfall onset dates were correlated with data series of average 5-day maximum and minimum temperatures, wind speed and direction data series for the 1st 90 days of the year (January-March).

4.0 RESULTS

4.1 Determining the right time to plant in the March-May rainfall season

Table 4.1: Indicators used by farmers to tell the right time for planting their crops.

No	Indicator	Percent
1	Trees sprout new leaves	2
2	Trees flower	2
3	Fog appear	2
4	Neighbor planting	2
5	Winds blow changing direction	3
6	Temperature cooling	3
7	Winds blowing eastwards	5
8	Soil getting wet	8
9	Swampy plants grow	10
10	Clouds forming	12
11	Month of March	32
12	Onset of rainfall season	45

Results **Table 4.1** reveal that the major indicator, farmers use to tell the right time to plant their crops is when rainfall season start. When rains set in the farmers wait for some days then they plant. Considering the traditional month of March of the calender is the next choice. Other criteria in importance include clouds forming in the sky, particular swampy plants growing and when the soil gets visibly wet.

4.2 Rainfall indicators used by farmers to forecast the March-May rainfall season

Table 4.2: Rainfall indicators used by farmers to forecast March-May rains in Soroti.

No	Indicator	Percent
1	Winds	**90**
2	Clouds	62
3	Birds	50
4	Trees	40
5	Temperatures	**28**
6	Thunder/Lightening	12
7	Dew	10
8	Month of March	8
9	Stars	7
10	Moon	3
11	Frog	3
12	Cows	3
13	Mist	2
14	Insects	2

Results in **Table 4.2**, show that the 5 major rainfall indicators, farmers use to forecast March-May rainfall season in decreasing importance are 1) **winds,** 2) clouds, 3) birds, 4) trees and 5) **temperatures.**

Each of the rainfall indicators has its various pattern of use by the farmers.

Both farmers and meteorologists observe the winds and temperatures of the place. This can be a good start to integrate farmer's knowledge with modern science to increase skills in forecasting seasonal rains.

4.3 How farmers use the rainfall indicators to forecast the March-May rainfall season

Table 4.3: How do farmers use the rainfall indicators to forecast March-May rainfall season.

	Rainfall indicator	Percent
	Winds blow eastwards	50
	Winds blow alternate directions	15
	Winds blow change direction	13
	Winds blow gently	10
	Winds blow strongly	2
	Winds blow westwards	2
	Clouds darken	62
	Birds make noise	43
	Birds migrate	8
	Trees flower	30
	Trees sprout new leaves	20
	Trees fruit	3
	Temperatures cool	17
	Temperatures hot	10
	Temperatures unstable	2
	Thunder and lightening	12
	Dew	10
	Month of March	8
	Star arrangement	5
	Moon yellowish	3
	Misty	3
	Frogs croak	3
	Insects	2
	Cows excited	2
	Swampy plants grow	2

The results in **Table 4.3,** above reveal the parameters of the rainfall indicators farmers use to forecast the March-May rainfall season for Soroti. The parameters of the wind rainfall indicator include the *direction and speed*. As regards wind direction these include the winds blowing westwards, change of direction, blowing in alternate directions and blowing eastwards. The most popular parameter appears to be winds blowing eastwards as it was reported by 50% of the farmers.

The most popular indicators used by the farmers are the clouds. Farmers observe the sky to monitor the amount and direction the dark clouds are forming. The birds are used to forecast the rains based on the nature of their migration and the noise they make at a particular time of the year. The trees are used to forecast on the basis of their physiological stages. At a particular time of the year some trees sprout new leaves, other flower and fruit.

The temperatures of the place are basically used depending on the degree of hotness or coldness during the dry season.

4.4 How farmers use the rainfall indicators to forecast, onset, levels and length of the March-May seasonal rains for Soroti.

Table 4.4 Percentage of farmers using the rainfall indicators to forecast onset, levels and length of the March-May seasonal rains.

	Rainfall Onset		Rainfall Amounts		Seasonal Length	
Seasonal Rainfall Indictors	**Early**	**Late**	**Above**	**Below**	**Long**	**Short**
Radio	0	0	**2**	0	0	0
Winds blow undefined	**2**	0	0	**3**	**3**	**2**
Winds blow gently	**3**	0	**2**	**2**	**3**	**5**
Winds blow strongly	0	**12**	**10**	**12**	**12**	**5**
Winds blow change direction	**17**	0	0	0	0	0
Winds blow westwards	**2**	**5**	0	0	0	**3**
Winds blow westwards strongly	0	**15**	0	**2**	0	0
Winds blow eastwards	**20**	**2**	0	0	**3**	**2**
Winds blow eastwards strongly	0	0	**3**	0	**2**	0
Winds blow northwards	0	0	0	**2**	0	0
Clouds clear	0	**37**	0	**40**	0	**27**
Clouds darken	**38**	**2**	**47**	0	**32**	**2**
Previous seasonal rains ended late	0	**7**	0	0	0	0
Previous seasonal rains ended early	**5**	0	0	0	0	0
Previous seasonal rains little	0	0	**3**	0	0	0
Previous seasonal rains plenty	0	0	0	**2**	0	0
Temperatures low	**13**	**2**	**3**	0	**3**	**7**
Temperatures high	**3**	**20**	**2**	**3**	0	0
Birds migrate few	0	0	0	**2**	0	0
Birds migrate many	0	0	**2**	0	0	0
Moon yellow	0	0	**3**	0	0	0
Moon clear	0	0	0	**2**	0	0
Stars	0	0	**2**	0	0	0

Results in **Table 4.4** show how farmers use the various rainfall indicators to forecast the onset, amounts and length of March-May seasonal rains within Soroti region. The popular indicators include, I) winds, ii) clouds, iii) previous seasonal rains, iv) temperatures v) birds, vi) moon and vii) stars and viii) radio. These indicators appear during the *dry season preceding March-May* seasonal rainfall. The figures show the percentage of farmers who use the rainfall indicators.

4.4.1 Forecasting onset of seasonal rains:

Winds (direction and speed)

The *wind direction and speed,* feature as good indicators of onset of rainfall seasons. The *blow of the winds eastwards* and the *change of wind direction*, are used by 20% and 17% of the farmers respectively, to forecast *early onset* of a rainfall season. *Late onset* of a rainfall season is detected by 15% of the farmers; using the *blow of the wind westwards* and 12% of the farmers use the *strong blow of the winds*.

The results suggest that at a particular time of the year, the presence of strong winds blowing westwards indicate a late onset while the presence of gentle winds blowing eastwards indicate early onset. The time when the winds change direction of blowing westwards to eastwards is a critical indicator to forecast onset of a rainfall season.

Clouds (clear and dark)

38% of the farmers use *dark clouds* to forecast *early onset of rainfall seasons*, while 37% of the farmers use *clear clouds* to forecast *late onset of rainfall seasons*. The presence of the dark clouds at a

particular time of the year, indicate onset of a rainfall season, while their absence indicate the rainfall onset shall be late.

Previous seasonal rains

Farmers use the performance of the preceding rainfall season, as an indicator of the performance of the next rainfall season. For example 5% of the farmers indicate that when the preceding *rainfall season ends early*, the next rainfall season is expected to *begin early*. In another scenario, 7% of the farmers indicate that when the preceding *rainfall season ends late*, the next season is expected to *start late*. This suggests that for this region, the *time of cessation* of the preceding rainfall season is directly related to *onset time* of the next rainfall season. This requires validation with using historical data.

Temperatures (high and low)

Results indicate that 13% of the farmers use *low temperatures* of the place as an indicator of *early onset* of the rainfall season. Meanwhile 20% of the farmers use *high temperatures* of the place as indicator of a *late onset*. This suggests that during a particular time of the year, the change of temperatures from the average temperature of the place may indicate the onset time of rainfall season.

4.4.2 Forecasting levels of a rainfall season

Winds (speed and direction)

Results indicate that 10-12% of the farmers use the strong wind blow to detect above and below rainfall amounts. The *gentle blow of the winds* is also used by 2% of the farmers forecast above and below rainfall amount. When the wind speed is coupled with direction, the results indicate, that 3% and 2% of the farmers use *strong wind blow eastwards* and *strong wind blow westwards* to forecast *above and below normal rainfall amounts* respectively. As such the *strength and direction of the wind blow* of a place during a pre-wet season period of the year may be used to forecast the amounts of a rainfall season.

Clouds (clear and dark)

47% of the farmers use the presence of dark clouds to forecast above normal rains, while 40% of the farmers use clear clouds to forecast below normal rains for the season.

Previous seasonal rains (above and below normal)

Farmers use the performance of the 2nd rainfall season of the preceding year, to forecast the rainfall amounts of the 1st wet season of next year. The little rainfall amounts of a preceding rainfall season is used by 3% of the farmers to forecast that the next rainfall season will have plenty of rainfall amount. Like wise plenty of rainfall amounts of the preceding rainfall season, is an indication to 2% of the farmers that the next rainfall season is expected to have little rainfall amounts. This suggests that records of rainfall amounts for the 2nd wet season for the preceding year may be used to forecast seasonal rainfall amounts for the next 1st wet season.

Temperatures (low and high)

3% and 2% of the farmers use low temperatures to forecast above normal rainfall amounts of the next rainfall season. However 3% of the farmers use high temperatures to forecast below normal seasonal rains.

Birds (migrate, make noise)

The number of birds migrating is used by 2% of farmers to forecast rainfall amounts. When few birds migrate, this is an indication that the next season is expected to have little rainfall amounts. Migrations of many birds indicate plenty of rainfall amounts for the next rainfall season.

Moon (white and yellowish)

A white moon indicates below normal seasonal rains (2% of the farmers) while a yellowish moon indicate above normal seasonal rains (2% of the farmers).

Radio Announcements

2% of the farmers use the radio to listen to the advise on the amounts of rainfall in the season.

5.0 Validation of Farmers forecasting practices

5.1 March-May 2003 rainfall farmers seasonal forecast

Table 5.1: Farmer's forecast of first wet season 2003

Onset	%
Early	30
Normal	32
Late	33

Amount	%
Above	28
Normal	42
Below	12

Length	%
Long	18
Normal	43
Short	23

The figures above suggest that the seasonal forecast for the 1st wet season would be as follows. The onset of the seasonal rains was expected to be normal to late. However the figures are not significantly different. The rainfall amounts were expected to be normal to above normal, while the length of the season was expected to be normal to short season. However the figures for the onset are not significantly different.

Scientific forecast for the first wet season 2003

March – May 2003: Central Eastern (Pallisa, Mbale, Kapchorwa, Kumi and Soroti)

The region has been mostly dry. It is expected to remain mainly dry with occasional outbreaks of rain/showers from about mid-March giving way to steady rains around early April. There is an increased likelihood of normal to above normal rains.

The above forecast is an extract from the climate forecast for March-May issued by the Department of Meteorology during the 2nd week of March 2003. This was following the regional climate forecast from the Outlook Forum by Drought Monitoring Center Nairobi

5.2 Performance of the seasonal rains for the first wet season 2003

Table 5.2: Historical onset dates

Year	Onset Dates	Departure	Onset Time
1990	95	0	On time
1991	95	0	On time
1992	95	0	On time
1993	120	25	Late
1994	80	-15	Early
1995	75	-20	Early
1996	80	-15	Early
1997	100	5	Late
1998	130	35	Late
1999	75	-20	Early
2000	80	-15	Early
2001	95	0	On time
2002	90	0	On time
2003	**110**	**15**	**Late**
Mean	95		

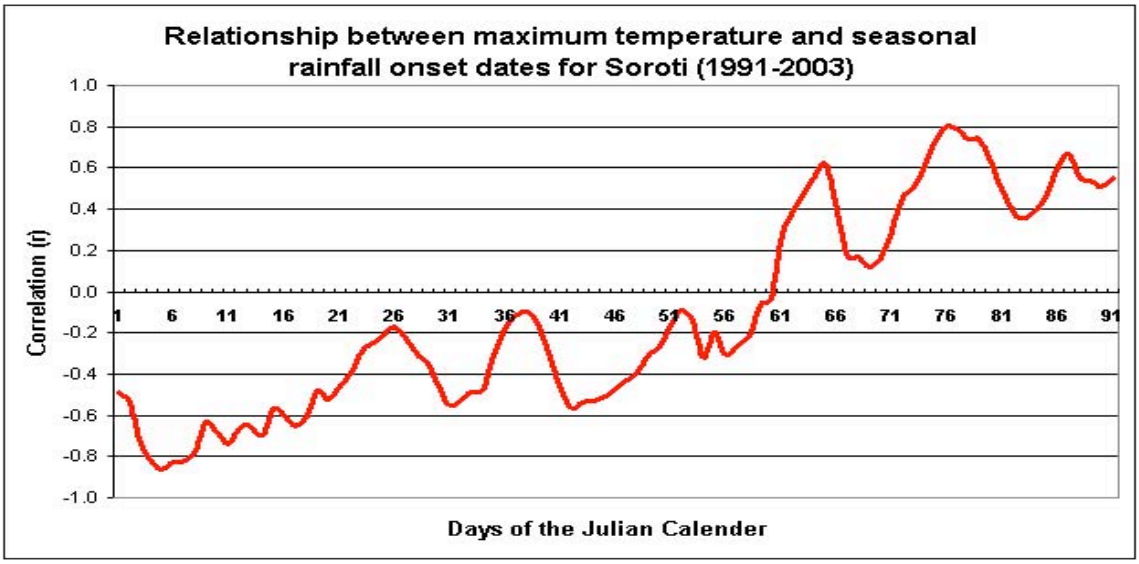
Criteria used to determine onset dates using INSTAT software.

Earliest Julian Day: 60
Threshold Rain day: 4.95mm
Days Totaled: 5
Rainfall Amount: 20
Rain Days out of 5: 3

Table 5.2 reveals that the onset of the 1st wet season began late by 15 days. Though 33% of the farmers had predicted late onset of seasonal rains, the number was not significantly different with 32% of the farmers who forecasted normal onset.

5.3 Relationship of the rainfall indicators and onset dates, of the March-May seasonal rains for Soroti Region.

Figure 5.1: Relationship between maximum temperatures with onset dates, for Soroti March-May seasonal rains.



Results in figure 5.1, suggest that there is a negative relationship between onset dates of seasonal rains and maximum temperatures for the first 60 Julian days. After which the relationship changes to a positive relationship during 60-90 Julian days. In particular there is a strong correlation(r=-0.84) during the 1-8 Julian days. The negative correlation changes gradually to a strong positive correlation (r=+80) during the 70-79 Julian days.

Figure 5.2: Relationship between wind speed with onset dates, for Soroti March-May seasonal rains.

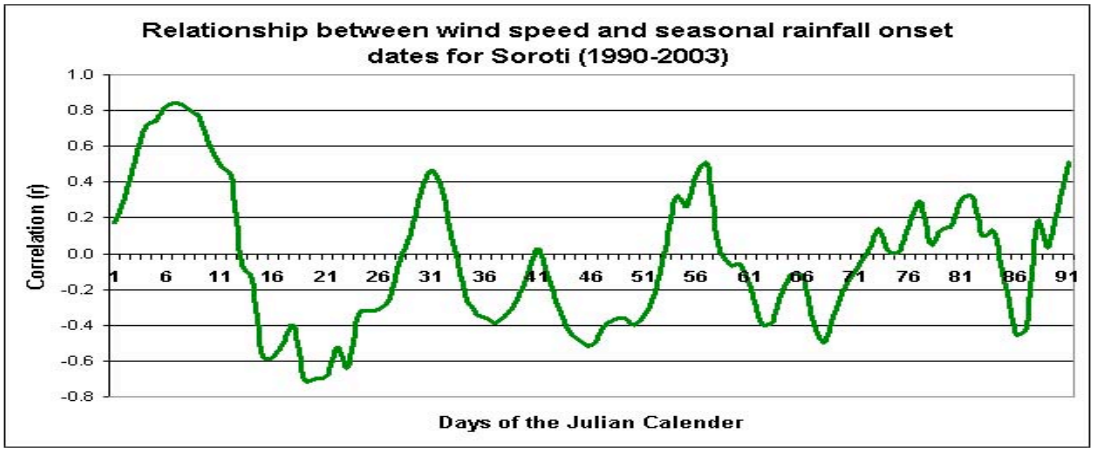


Figure 5.2, above, shows the relationship between the wind speed and onset dates of March-May seasonal rains. A strong positive(r=+0.84) correlation is during the 1-8 Julian days. However, the relationship fluctuates from negative to positive somehow like in cycles.

6.0 Discussion.

6.1 Rainfall indicators farmers use to forecast seasonal rains

The study reveals that the popular rainfall indicators, farmers use to forecasts rains are as follows in order of decreasing importance I) winds 52%, ii) clouds 23%, iii) trees 9%, iv) birds 7% and v) temperatures 4%. The use of these indicators by farmers indicates the great need for climate forecasts. Among the 5 major rainfall indicators used, both scientists and farmers observe the winds and temperatures. This provides a good starting base to build a mutual sharing of knowledge and experiences of forecasting seasonal rains to both parties.

6.2 Local wind direction and speed

The direction and speed of winds are important features farmers use to forecast seasonal rains. During the January-March dry season, the winds usually blow strongly westwards. As the seasonal rains are approaching, the winds change direction, and blow eastwards. Winds blowing eastwards winds are heavily linked with onset of seasonal rains. The above farmers' observations are consistent with findings by (Camberlin and Weirton, 1997) and Okolona, 1998). As such observing the time of the year when the winds change direction from blowing westwards to eastwards of the region could be used to forecast ahead of time when seasonal rains may start.

Statistical analysis between the two variables reveals unstable relationship alternating from positive to negative directions. However, for the interests of forecasting onset of the rains, there is a strong positive (r+0.80) correlation during the 1st 1-8 Julian days between the two variables. This implies that the *stronger the winds blow westwards* the *later the seasonal rains start*. This is in line with the farmer's observations, that strong winds blowing westwards indicate late onset.

Statistical analysis by INSTAT shows, that the average onset period for March-May seasonal rains is around 91-95 days. This suggests that stronger westwards winds during 1-8 Julian days may indicate that the seasonal rains may set in later than 91-95 Julian days and weaker westward winds may indicate onset of seasonal rains earlier than the usual date. Additionally the forecast can be made in 3-month time ahead of the season.

6.3 Local temperatures

Farmers use local temperatures in two ways. During the January-March dry season, hot temperatures of the place indicate late onset of the seasonal rains while cool temperatures indicate early onset of

seasonal rains. This suggests that monitoring the changes in temperatures of the place during the dry season could be used to forecast the seasonal rains.

However statistical analysis of the relationship between onset dates and maximum temperatures as shown in Figure 8.1 reveal the strongest negative correlation(r=-086) is during the Julian days 1-8 and later the relationship develops into strong positive correlation (r=+0.80) during the days 71-79 of the Julian year. The later positive relationship suggests that the hotter the temperatures, the later is the onset while the cooler the temperatures the earlier the rains set in.. This relationship could be used to forecast the seasonal rains ahead of 2-3 weeks of time ahead.

With the previous negative relationship between the two variables during the start of the year, this suggests, that the hotter the temperatures during that period, the earlier the onset and the cooler the temperatures, the later is the onset. This relationship may explain why the farmer's believe that when the preceding 2nd seasonal rains end early this indicates an early onset of the March-May rains and the vice versa. Early end of the 2nd rains may encourage early development of hotter temperatures during the first 8 Julian days while late end of the 2nd rains may prolong the development of hotter temperatures in the dry season. The lag period for this relationship is 3 months that may enable forecasting the start of the season a head of a long time.

6.4 Priority farmer's climate information needs

Table 6.1 Farmers climate information needs

Climate information Needs	%
None	**5**
Rainfall amounts	**7**
How rains form	**8**
Planting time	**8**
Why rains patterns have changed	**12**
Forecasting rains	**20**
Onset of seasonal rains	**40**
Total	**100**

Results in **Table 6.1** reveal that *onset of seasonal rains* is the major climate information farmers need compared to *rainfall amounts* that is the dominant feature in scientific climate forecasts. The need for information has been highlighted for onset time of seasonal rains has been highlighted by (Roncoli, 2000, and Onyewotu et al, 2000).

Additionally the farmers would like information on how to forecast the seasonal rains. The stimulus for this interest may be linked with the need for local specific forecasts (Srinivasan, 2000) than the regional ones produced by climate scientists. These finds suggests that climate scientist should produce climate information products that are needed by the end users.

7.0 Conclusion

The above study reveals some common practices exist that farmers and meteorologist practice as regards observing atmospheric conditions in pursuit to forecast seasonal rains for crop production. Such findings are in line with studies by (Roncoli et al, 2000). The farmer's practice of forecasting rains using their rainfall indicators highlights the importance of climate forecasts to them.

Donnelly 1998, points out that recent developments focus on capacity and institutional building. Farmers use there indigenous knowledge at the local level as the basis for decisions pertaining to food security, human and animal health, education, natural resources management, and other vital activities. As such building(Gorjestani 2000) on indigenous knowledge can be particularly effective in helping to reach the poor since indigenous knowledge is often the only asset they control, and certainly one with which they are very familiar. Understanding the farmers practice in forecasting seasonal rains may help the climate scientists improve their services to the end users.

8.0 Recommendations

- Meteorologists should take efforts to improve on the farmer's knowledge to build their capacity to make local specific forecasts.

- Develop local specific models to forecast onset of seasonal rains using local maximum temperatures and wind speeds.

- Replicate the research study for other regions with long historical data.

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Field Questionnaire

***For the Interviewer**: (1) The interviewer will fill the questionnaire with answers to every question he/she asks the farmer. (2) Some questions require ticking in the boxes provided as per the answers given. (3) Where necessary make some notes regarding extra information given by the farmer or any question you may ask.*

1.0 Identity

1.1 Interviewer Particulars.

Names…….

1.2 Respondent Identity

Names ……Sex ……... Age……
Highest education attained: ∉Primary, ∉Secondary, ∉Post Secondary, ∉None
District…….. County……Sub County……..
Parish……..Village……

2.0 Production system

2.1 Livelihood/Main source of income
∉Crop farming, ∉Livestock, ∉Fishing, ∉Business, ∉Others

2.2 Major three cash crops grown *(in decreasing order of importance)*
1)…… 2)…… 3)……

2.3 Major three food crops grown *(in decreasing order of importance)*
1)…… 2)…… 3)……

2.4 Major three (animals) livestock kept *(in decreasing order of importance)*
1)…… 2)…… 3)……

2.5 Main three production problems faced on farm *(in decreasing order of importance)*
1) Land pressure, 2) Labor shortages, 3) Climate issues, 4) Crop Varieties,
5) Marketing, 6)Pests diseases, 7)others

1)…… 2)…… 3)……

3.0 Local climate information

3.1 What are the most disturbing weather conditions that prevail most, in your area?
……
……
……..……

3.2 What are the main three farming activities most affected by the above?
1)…… 2) ……3)……

3.3 How many (wet) planting seasons do you have in a year? ……
3.4 What are the local (indigenous names) for the (wet) planting seasons?
……..……

3.5 How long (*in months*) is/are the planting seasons ……

3.6 Why were the (wet) planting seasons named like that?
……
……

3.7 How many dry seasons do you have in a year?
…….

3.8 What are the indigenous names for the dry seasons?
……
……

3.9 How long (*in months*) are these dry seasons? ……..

3.10 Why were the dry seasons named like that?
……
……

4.0 Indigenous seasonal rainfall indicators

4.1 How do you tell the right time for planting your crops?
……
…….…….

4.2 What are the major rainfall indicators you use to tell the onset of seasonal rains?
……..……
……..…….……
……

4.3 Which wet planting season is easier for you to forecast?

∉1st wet season ∉ 2nd wet season

5.0 How do you tell ahead of time, whether there will be?

5.1 an early onset rainfall seasonal
……
……
……..……

5.2 a normal onset of rainfall seasonal
……
……
……..……

5.3 a late onset of rainfall seasonal
……
……
……

5.4 At what period of time can you tell before the rainfall season begins? …….

6.0 How do you tell ahead of time, whether the rainfall season will be?

6.1 above normal rainfall amount

……
……
……..……

6.2 normal rainfall amount

……
……
……

6.3 below normal amount

……
……
……

6.4 At what period of time can you tell before the rainfall season begins? ……..

7.0 How do you tell ahead of time, whether the rainfall season will be?

7.1 Short length of rainfall season

……
……
……

7.2 normal length of rainfall season

……
……
……

7.3 long length of rainfall season

……
……
……

7.4 At what period of time can you tell before the rainfall season begins? …….

8.0 Current Use and Accuracy of the indicators

8.1 Which indicators are more reliable to use?

……

8.2 How many indicators can you use at a time? …….

8.3 Out of every 5 forecasts how many come true? ……..

9.0 Farmers forecast of the next rainfall season 2003

9.1 Expected time of onset of next rainfall season (2003)

	Expected time of onset	**Based on what rainfall indicators?**
	Early Onset	
	Normal onset	
	Late	

9.2 Expected rainfall amount of the next rainfall season (2003)

	Expected rainfall amounts	**Based on what rainfall indicators?**
	Below Normal	
	Normal Amount	
	Above Normal	

9.3 Expected duration of the next rainfall season (2003)

	Expected Length rainfall season	**Based on what rainfall indicators?**
	Short length	
	Normal length	
	Longer length	

10.0 Farmers Proverbs, sayings and beliefs on winds, temperatures and seasonal rains

10.1 What proverbs, idioms do you have concerning winds temperatures and rains?
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……
……..……
……..……

10.2 What would you like to learn from a weatherman?
……
……

10.3 What would you like to learn from a fellow farmer on forecasting seasonal rainfall?
……
……

10.4 Would you like to participate in a farmer's group discussion on indigenous methods of forecasting rainfall seasons? ∉YES, ∉NO

THANKS